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March 8, 2004

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**The Director of the United States  
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*Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.*

*Therefore; this*

**United States Patent**

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*If this application was filed prior to June 8, 1995, the term of this patent is the longer of seventeen years from the date of grant of this patent or twenty years from the earliest effective U.S. filing date of the application, subject to any statutory extension.*

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US006151532A

**United States Patent** [19]

Barone et al.

[11] **Patent Number:** **6,151,532**[45] **Date of Patent:** **Nov. 21, 2000****[54] METHOD AND APPARATUS FOR PREDICTING PLASMA-PROCESS SURFACE PROFILES****[75] Inventors:** Maria E. Barone, Sunnyvale; Richard A. Gottscho, Pleasanton; Vahid Vahedi, Albany, all of Calif.**[73] Assignee:** Lam Research Corporation, Fremont, Calif.**[21] Appl. No.:** 09/033,997**[22] Filed:** Mar. 3, 1998**[51] Int. Cl.<sup>7</sup>** ..... G06F 19/00**[52] U.S. Cl.** ..... 700/121; 700/46; 700/47; 700/108; 700/109; 700/117; 700/123; 438/729; 324/460; 324/464; 204/192.13; 204/192.33**[58] Field of Search** ..... 700/32, 34, 46, 700/47, 48, 108, 109, 121, 117, 123, 28, 29, 31, 44; 438/729; 324/460, 464; 204/192.13, 192.33**[56] References Cited****U.S. PATENT DOCUMENTS**

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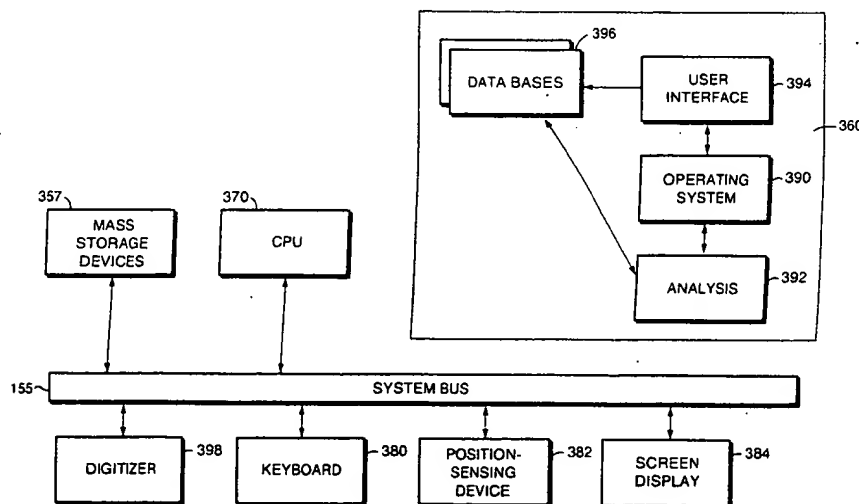
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Assistant Examiner—Ramesh Patel

Attorney, Agent, or Firm—Cesari and McKenna, LLP

**[57] ABSTRACT**

The invention provides a method for predicting a process surface profile that a given plasma process will create on a process substrate. The prediction is based on a test surface profile, the experimental outcome of a test process which is in general different from the plasma process of interest. In another aspect, the invention provides a technique for defining a plasma process that will produce a desired surface profile. Thus, in related aspects, the invention also provides apparatus for predicting a process surface profile and determining process values, a method of configuring a plasma reactor, a method of making semiconductor devices requiring limited empirical calibration, and a device made according to the method.

**28 Claims, 3 Drawing Sheets**

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